Il Sole 24 ORE

RISCHIO EFFETTO SERRA

Allarme della Wmo: nel 2015 raggiunti livelli record di CO2

24 ottobre 2016

Per la prima volta da quando questi dati vengono registrati a livello globale, nel 2015 la concentrazione media annua di biossido di carbonio (CO2) nell'atmosfera terrestre, ha raggiunto la soglia delle 400 ppm (parti per milione). Secondo infatti la Wmo (World Meteorological Organization, Organizzazione meteorologica mondiale), i livelli di biossido di carbonio avevano già raggiunto questa soglia, ma solo in alcuni mesi dell'anno e in certi luoghi, ma mai prima d'ora era accaduto su base media globale e per l'intero anno. E la situazione non pare affatto migliore per l'anno in corso: secondo l'Omm, infatti, le concentrazioni di CO2 resteranno al di sopra di 400 ppm per l'intero 2016 (anche a causa del fenomeno El Niño) e non scenderanno sotto tale livello nemmeno nel prossimo futuro.

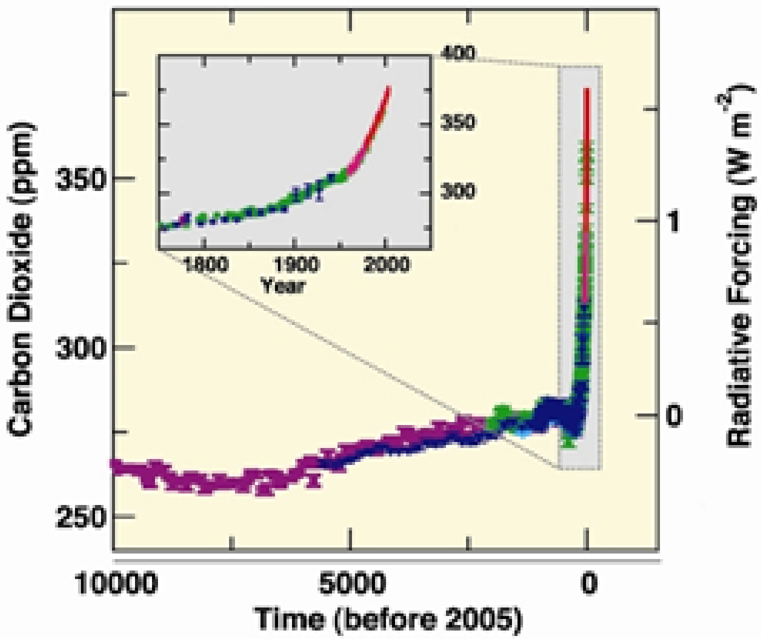
«Tra il 1990 e il 2015 c'è stato un aumento del 37% nell'effetto radiante (l'effetto di riscaldamento sul clima) a causa dei gas ad effetto serra a lunga persistenza -continua ancora il comunicato Wmo- quali anidride carbonica, metano e protossido di azoto (N2O), dovuti ad attività industriali, agricole e domestiche».

La crescita sostenuta di CO2 è stata alimentata dall'evento El Niño, sottolinea il comunicato. Ma mentre «l'evento di El Niño è scomparso, i cambiamenti climatici restano», ha affermato il segretario generale dell'Omm, il finlandese Petteri Taalas. Il 2015 - ha aggiunto - resterà nella storia nella misura in cui le concentrazioni record di gas a effetto serra «annunciano una nuova realtà climatica».

Taalas si è felicitato del recente accordo raggiunto a Kigali per modificare il Protocollo di Montreal ed eliminare gradualmente gli idrofluorocarburi, potenti gas serra, «ma il vero elefante nella stanza è l'anidride carbonica che rimane nell'atmosfera per migliaia di anni e negli oceani ancora più a lungo. Se non si affrontano le emissioni di CO2 non saremo in grado di affrontare i cambiamenti climatici e di mantenere l'aumento della temperatura al di sotto dei 2 grandi centigradi rispetto al livello dell'era pre-industriale» ha aggiunto, esortando un'accelerazione dell'applicazione dell'accordo di Parigi sul clima del dicembre 2015. *(f.s.)*

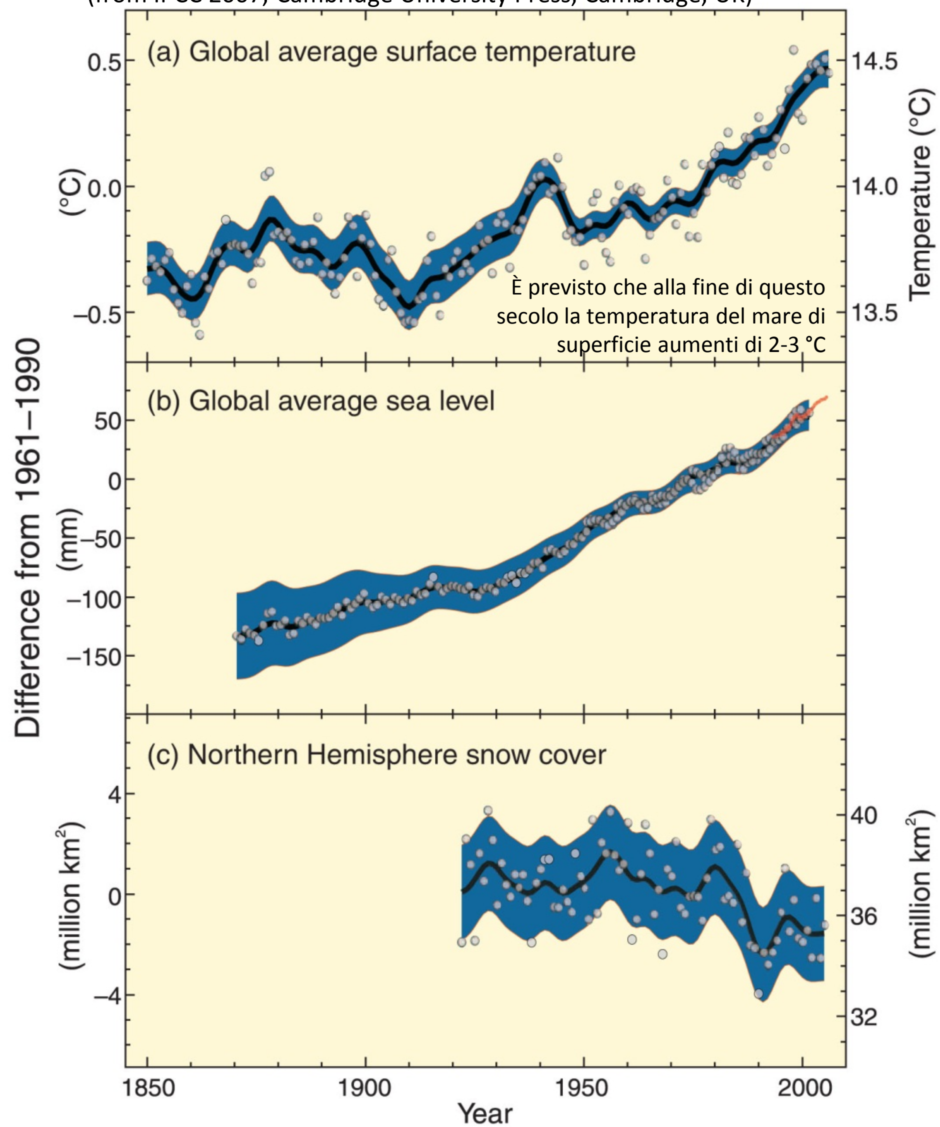
Oggi siamo arrivati a 380 ppm, la più alta concentrazione degli ultimi 800 mila anni (Luthi et al. 2008, *Nature*, 453: 379-382). Un tasso di incremento di CO_2 così rapido come quello di oggi non si è mai verificato nel corso dei tempi geologici (Pandolfi et al. 2011, *Science*, 333: 418-422).

Change in greenhouse CO_2 gas from ice core and modern data



"Atmospheric concentration of CO_2 over the last 10,000 years (large panel) and since 1750 (inset panel). The corresponding radiative forcing is on the right axis of the large panel; positive forcing warms the Earth's surface" (IPCC 2007, *Cambridge University Press, Cambridge, UK*).

Changes in temperature, sea level and Northern Hemisphere snow cover
(from IPCC 2007, Cambridge University Press, Cambridge, UK)



Sky TG24, 13/11/2016, ore 12:00 PM

«Il climate change è una bufala!»

«In effetti, è venti anni che se ne parla, ma non è successo molto!»

«Sono a metà d’accordo con Trump, ma un certa attenzione per l’ambiente bisogna mantenerla»

Regime Shifts in the Marine Environment: How Do They Affect Ecosystem Services?

[Kraberg A. C., Wiltshire K. H., 2014. Regime Shifts in the Marine Environment: How Do They Affect Ecosystem Services? In: Goffredo S., Dubinsky Z. (eds) The Mediterranean Sea: Its history and present challeges. Springer, Dordrecht, p 499-504]

Coastal Zones

Defining coastal zones as those areas less than 10 m above sea level implies that 10 per percent of the worlds' population live in this coastal zone.

In Europe alone this amounts to roughly 50 million people (McGranahan et al. 2007; Nicholls et al. 2007).

Human population living in coastal areas is rapidly growing.

The human population increasingly relies on coastal seas for food, and coastal areas are also important for recreation, shipping and power generation (Remoundou et al. 2009).

These uses put increasing pressures on coastal ecosystem diversity and function.

These pressures will increase even further as the accelerating anthropogenic climate change forces upon us the greater need for coastal defence against sea level rise, storms and flooding with subsequent impacts on coastal ecosystems e.g. via habitat loss etc.

Regime Shifts in the Marine Environment: How Do They Affect Ecosystem Services?

[Kraberg A. C., Wiltshire K. H., 2014. Regime Shifts in the Marine Environment: How Do They Affect Ecosystem Services? In: Goffredo S., Dubinsky Z. (eds) The Mediterranean Sea: Its history and present challeges. Springer, Dordrecht, p 499-504]

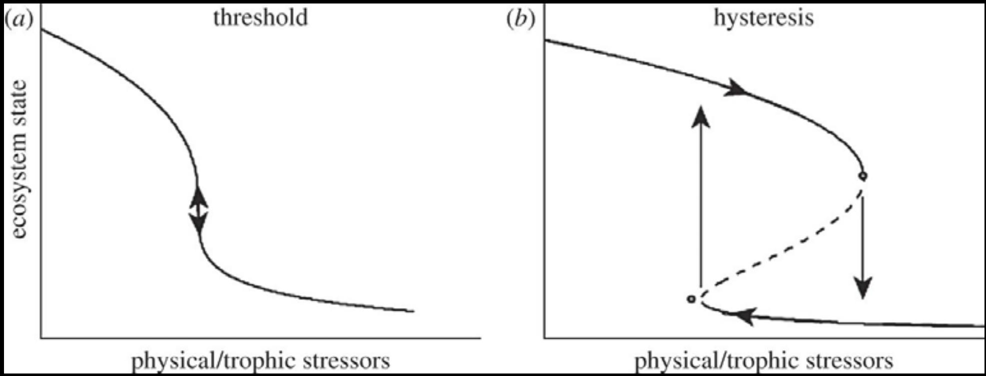
Biological Regime Shifts: Some Definitions

One class of abrupt changes in the environment is termed regime shifts.

Regime shifts refer to non-linear responses of a system to a driver even if that driver is showing only gradual change.

Rather than responding gradually, the system will initially show little response to the driver, but then, reaching a threshold 'x' (also called tipping point) move to a different system state (an alternative stable state) (Petraitis and Dudgeon 2004).

Importantly a small shift of the driver back in the direction of the original state will not be sufficient to move the system back to this original state a process known as hysteresis (Kinzig et al. 2006).



Examples of regime shift. Two different responses are shown, one without (a), and the other with hysteresis (b) (from Conversi A., Dakos V., Gårdmark A. et al., 2014, Philosophical Transactions Royal Society B, 370: 20130279).

Regime Shifts in the Marine Environment: How Do They Affect Ecosystem Services?

[Kraberg A. C., Wiltshire K. H., 2014. Regime Shifts in the Marine Environment: How Do They Affect Ecosystem Services? In: Goffredo S., Dubinsky Z. (eds) The Mediterranean Sea: Its history and present challeges. Springer, Dordrecht, p 499-504]

Biological Regime Shifts: Some Definitions

In the context of these abrupt shifts a further important concept is the 'resilience' of a system. The resilience refers to the ability of a system to absorb and regenerate/recover to disturbances without losing its overall structure and function (i.e. avoid the shift).

With respect to regime shifts the resilience can be regarded as the ease with which the system can be forced to move between the alternative states (the higher the resilience, the lower the probability to shift), and this is to some extent a function of the biodiversity and structure of the ecosystem.

The species in a biological community are intricately linked through interactions such as competition and predation and alterations in these interactions can influence the ability of a system to recover from a given stress (Scheffer et al. 2001a; Kinzig et al. 2006).

Regime Shifts in the Marine Environment: How Do They Affect Ecosystem Services?

[Kraberg A. C., Wiltshire K. H., 2014. Regime Shifts in the Marine Environment: How Do They Affect Ecosystem Services? In: Goffredo S., Dubinsky Z. (eds) The Mediterranean Sea: Its history and present challeges. Springer, Dordrecht, p 499-504]

Biological Regime Shifts: Some Definitions

However, the consequences of climate change, such as rising air and water temperatures, sea level rise etc. are emerging as the dominant threats to ecosystem stability (Tol 2009).

From: NASA, What’s in a name? Weather, global warming and climate change. http://climate.nasa.gov/. Accessed 13/11/2016

Regime Shifts in the Marine Environment: How Do They Affect Ecosystem Services?

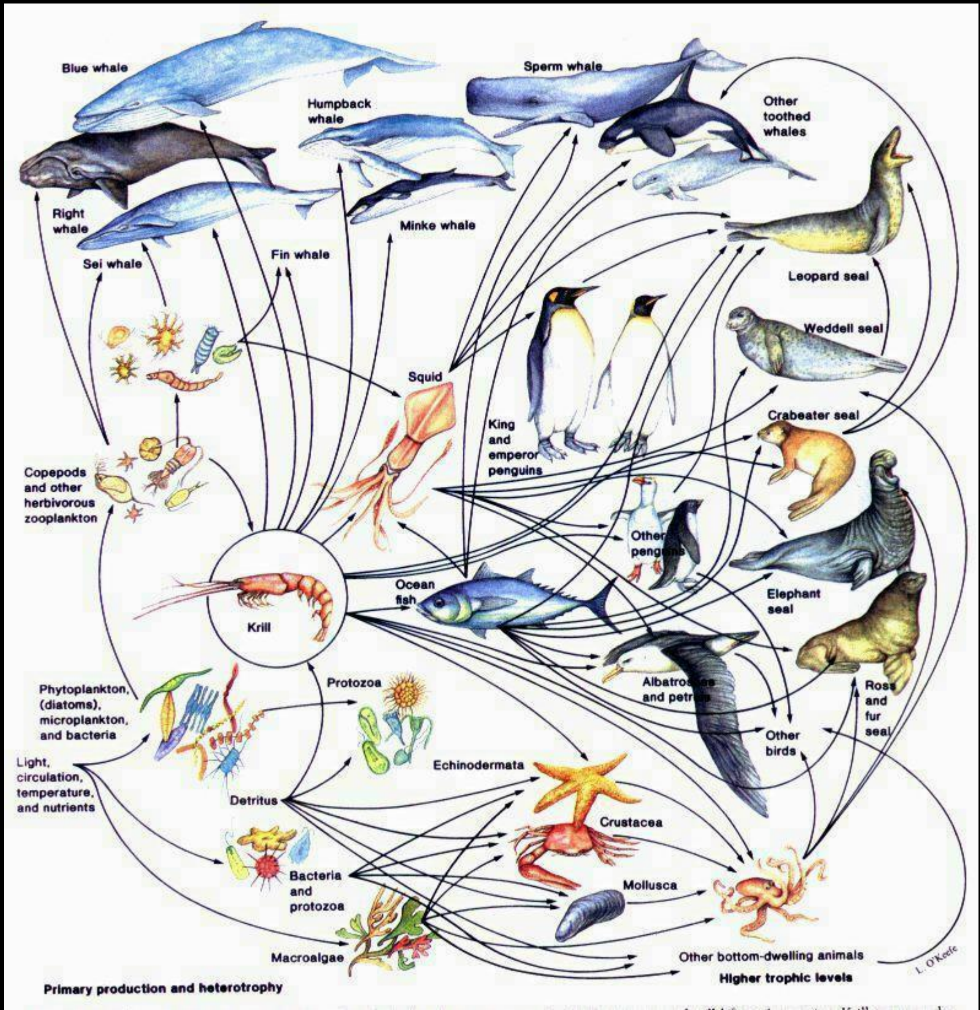
[Kraberg A. C., Wiltshire K. H., 2014. Regime Shifts in the Marine Environment: How Do They Affect Ecosystem Services? In: Goffredo S., Dubinsky Z. (eds) The Mediterranean Sea: Its history and present challeges. Springer, Dordrecht, p 499-504]

Ecosystem Regime Shifts in the Mediterranean

In the Ligurian Sea Molinero et al. (2008) described a shift in 1987/1988 from crustacean zooplankton (copepods) to an assemblage dominated by gelatinous zooplankton (jellyfish).

The observed changes in atmospheric forcing during the late 1980s (i.e. the rising air temperatures, and decreasing precipitation and wind stress) enhanced the stratification of the water column associated with a generally warmer period.

Subsequently, it is plausible that the environmental changes have induced substantial modifications in the hydrological regime of the Ligurian Sea, and thus have altered the composition and structure of phytoplankton communities, towards small phytoplankton (Molinero et al. 2008).



Regime Shifts in the Marine Environment: How Do They Affect Ecosystem Services?

[Kraberg A. C., Wiltshire K. H., 2014. Regime Shifts in the Marine Environment: How Do They Affect Ecosystem Services? In: Goffredo S., Dubinsky Z. (eds) The Mediterranean Sea: Its history and present challeges. Springer, Dordrecht, p 499-504]

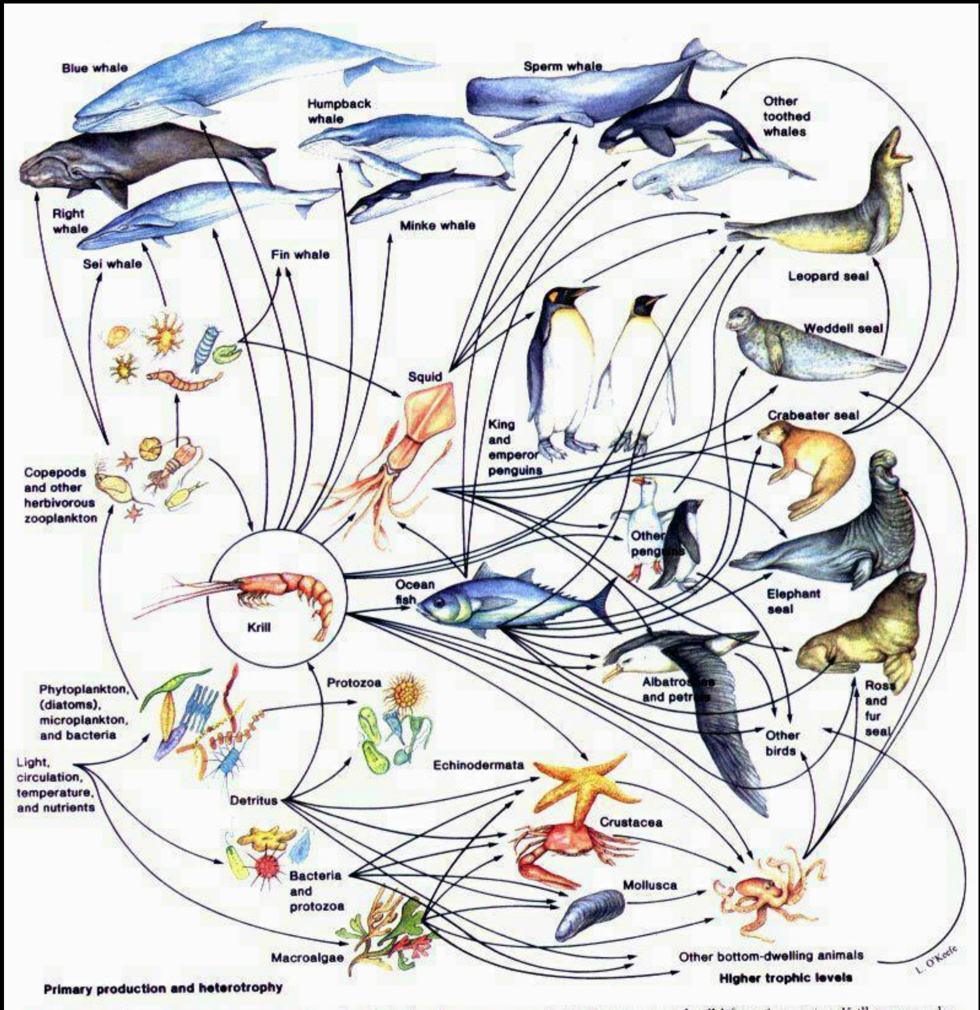
Ecosystem Regime Shifts in the Mediterranean

The rising trend in temperature and the consequent dominance of small phytoplankton affected the population growth of copepods. The size spectra of phytoplankton communities may greatly affect grazing efficiency of copepods (copepods do not feed on small phytoplankton), and any change in diet affects egg production (Molinero et al. 2008).

Warm temperature further increases food limitation that impairs growth and enhances mortality of adult stages of copepods (Molinero et al. 2008).

In addition, the governing environmental conditions during the 1980s (i.e. warm temperatures, low water column mixing) result in favourable conditions for jellyfish development (better survival and higher reproduction rate; Molinero et al. 2008).

Thus, copepods suffered a higher predation pressure due to the increasing frequency of jellyfish outbreaks during the 1980s (Molinero et al. 2008)



Regime Shifts in the Marine Environment: How Do They Affect Ecosystem Services?

[Kraberg A. C., Wiltshire K. H., 2014. Regime Shifts in the Marine Environment: How Do They Affect Ecosystem Services? In: Goffredo S., Dubinsky Z. (eds) The Mediterranean Sea: Its history and present challeges. Springer, Dordrecht, p 499-504]

Regime Shifts and Ecosystem Services

Ecosystem Services

Ecosystem services can be broadly defined as the sum of all benefits for mankind that are derived directly or indirectly from ecosystems and facilitate a healthy and safe life for local human populations (Fisher et al. 2008).

This definition includes a diverse array of different services, which the Millennium Assessment report has classed into four groups: provisioning (e.g. agriculture and fisheries) regulating (e.g. flood control), cultural and supporting ecosystem services (Millennium Ecosystem Assessment 2005a, b; Fig. 29.1). This subdivision already indicates the complexity of the different services.

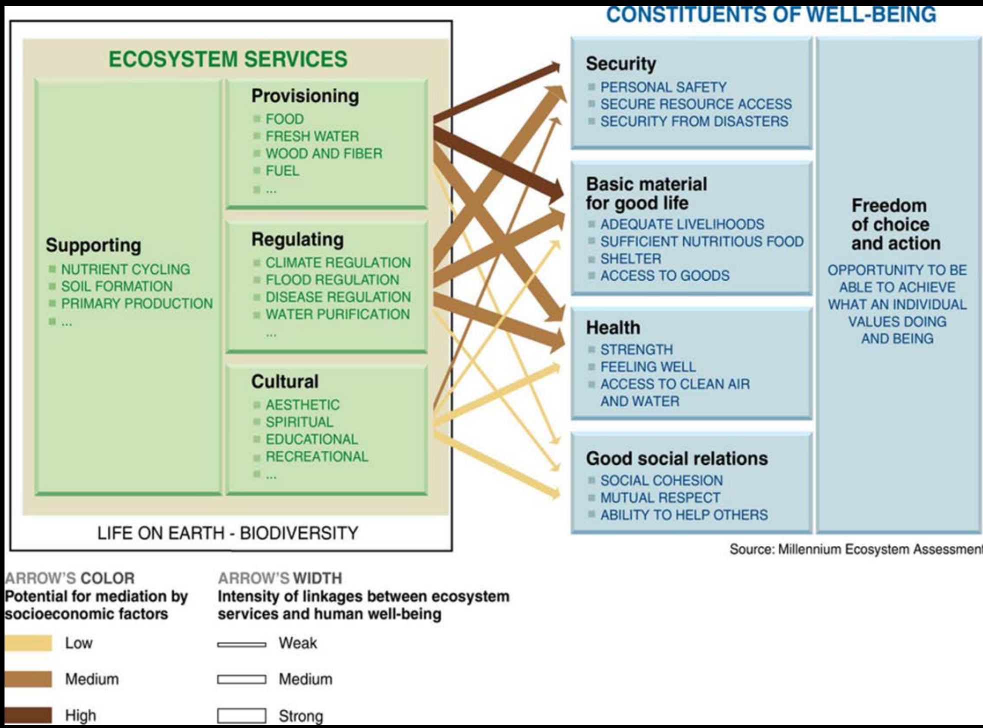


Fig. 29.1 Types and components of ecosystem services as defined by the Millenium Ecosystem Assessment.

Regime Shifts in the Marine Environment: How Do They Affect Ecosystem Services?

[Kraberg A. C., Wiltshire K. H., 2014. Regime Shifts in the Marine Environment: How Do They Affect Ecosystem Services? In: Goffredo S., Dubinsky Z. (eds) The Mediterranean Sea: Its history and present challeges. Springer, Dordrecht, p 499-504]

Regime Shifts and Ecosystem Services

Biodiversity, Regime shifts and Ecosystem Services

Biodiversity plays a central role in the functioning and stability of any ecosystem.

'Manipulation' of one part of this system can have dramatic and unforeseen, non-linear consequences in another, including the occurrence of biological regime shifts (for example, the growing importance of gelatinous zooplankton in different coastal areas, including in the Mediterranean; Molinero et al. 2008).

The economic impact of gelatinous plankton 'outbreaks' includes losses of commercial fish stocks.

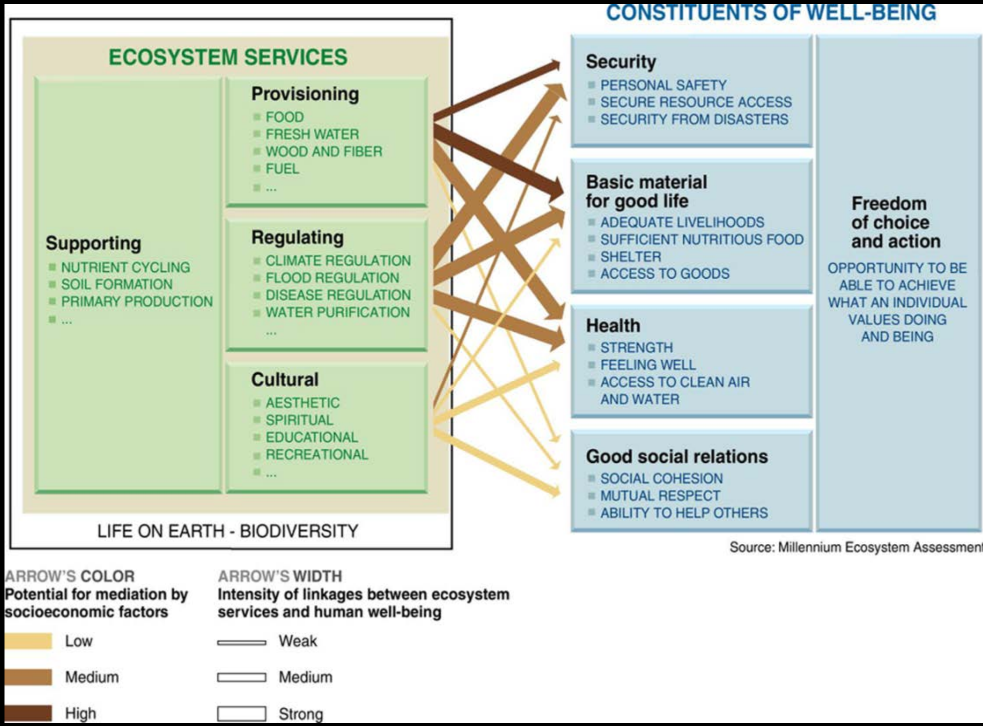


Fig. 29.1 Types and components of ecosystem services as defined by the Millenium Ecosystem Assessment.

Regime Shifts in the Marine Environment: How Do They Affect Ecosystem Services?

[Kraberg A. C., Wiltshire K. H., 2014. Regime Shifts in the Marine Environment: How Do They Affect Ecosystem Services? In: Goffredo S., Dubinsky Z. (eds) The Mediterranean Sea: Its history and present challeges. Springer, Dordrecht, p 499-504]

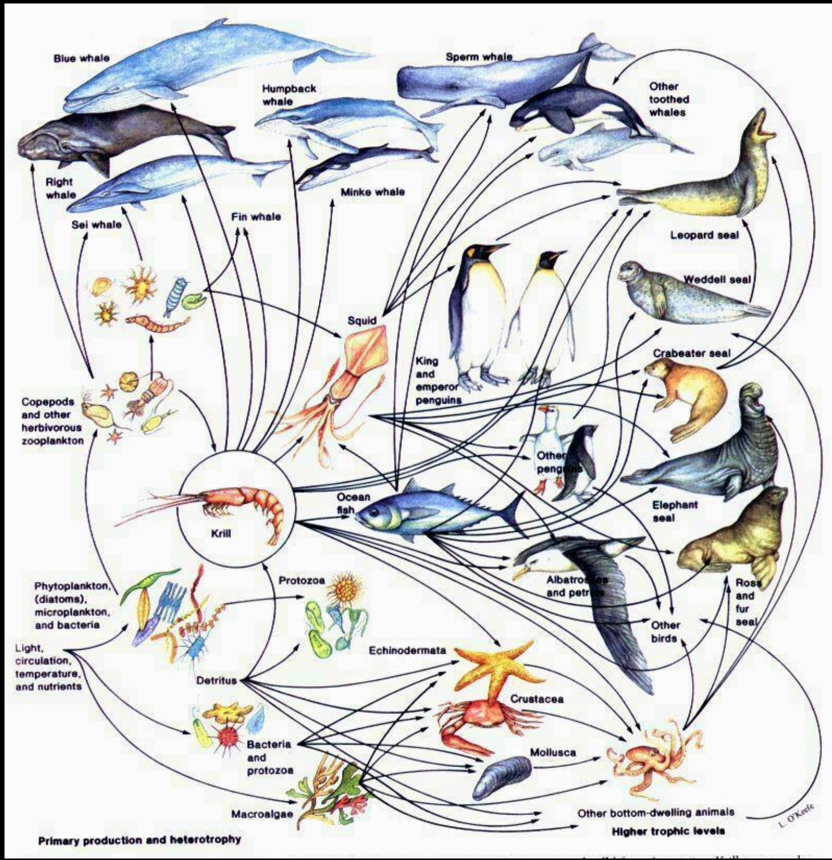
Regime Shifts and Ecosystem Services

Biodiversity, Regime shifts and Ecosystem Services

Biodiversity plays a central role in the functioning and stability of any ecosystem.

'Manipulation' of one part of this system can have dramatic and unforeseen, non-linear consequences in another, including the occurrence of biological regime shifts (for example, the growing importance of gelatinous zooplankton in different coastal areas, including in the Mediterranean; Molinero et al. 2008).

The economic impact of gelatinous plankton 'outbreaks' includes losses of commercial fish stocks.



Regime Shifts in the Marine Environment: How Do They Affect Ecosystem Services?

[Kraberg A. C., Wiltshire K. H., 2014. Regime Shifts in the Marine Environment: How Do They Affect Ecosystem Services? In: Goffredo S., Dubinsky Z. (eds) The Mediterranean Sea: Its history and present challeges. Springer, Dordrecht, p 499-504]

Regime Shifts and Ecosystem Services

<u>Biodiversity, Regime shifts and Ecosystem Services</u>

<u>Biodiversity plays a central role</u> in the functioning and stability of any ecosystem.

<u>‘Manipulation’ of one part of this system</u> can have dramatic and unforeseen, non-linear consequences in another, including the occurrence of biological <u>regime shifts (for example, the growing importance of gelatinous zooplankton in different coastal areas, including in the Mediterranean</u>; Molinero et al. 2008).

The economic impact of gelatinous plankton ’outbreaks’ includes <u>losses of commercial fish stocks</u>.

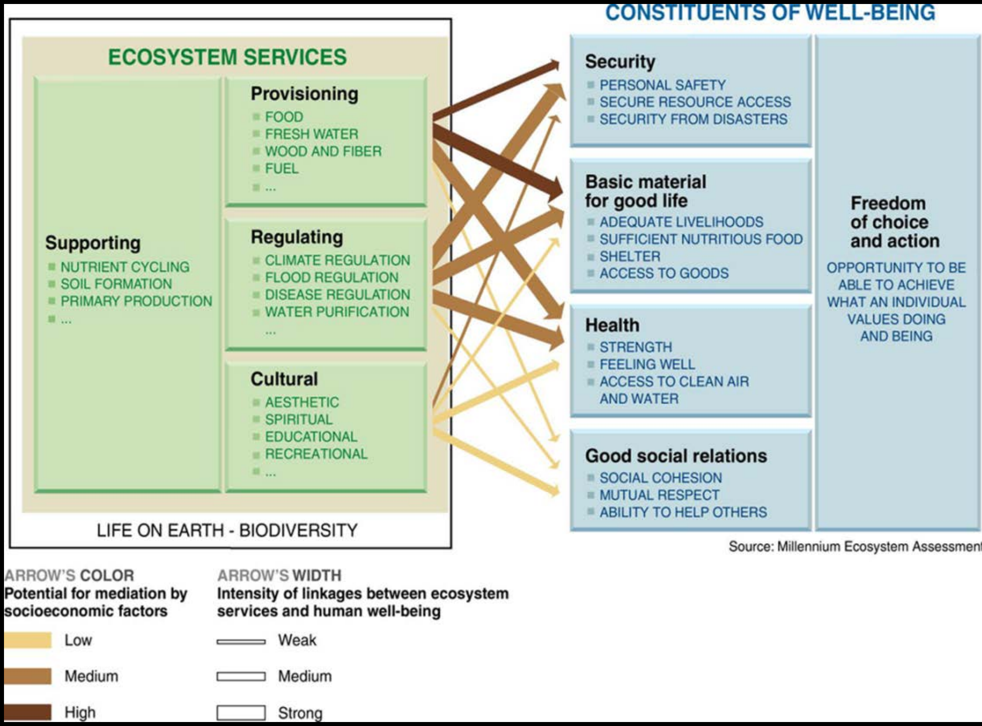


Fig. 29.1 Types and components of ecosystem services as defined by the Millenium Ecosystem Assessment.

Regime Shifts in the Marine Environment: How Do They Affect Ecosystem Services?

[Kraberg A. C., Wiltshire K. H., 2014. Regime Shifts in the Marine Environment: How Do They Affect Ecosystem Services? In: Goffredo S., Dubinsky Z. (eds) The Mediterranean Sea: Its history and present challeges. Springer, Dordrecht, p 499-504]

Regime Shifts and Ecosystem Services

Biodiversity, Regime shifts and Ecosystem Services

In the context of ecosystem services it is worth noting that it is not always biodiversity on the whole that is the subject of a valuation but individual species that might be valued by humans because they are associated with a certain region or are seen as iconic or representative of biodiversity in general.

Individual species might significantly enhance cultural ecosystem services such as tourism/recreation (examples in the Mediterranean are: tuna, dolphins, monk seals) irrespective of their true ecological or economic significance.

Blue fin tuna (*Thunnus thynnus;* Actinopterygii, Perciformes, Scombridae)

Common dolphin (*Delphinus* sp.; Mammalia, Cetacea, Delphinidae)

Monk seal (*Monachus monachus*; Mammalia, Carnivora, Phocidae)

Regime Shifts in the Marine Environment: How Do They Affect Ecosystem Services?

[Kraberg A. C., Wiltshire K. H., 2014. Regime Shifts in the Marine Environment: How Do They Affect Ecosystem Services? In: Goffredo S., Dubinsky Z. (eds) The Mediterranean Sea: Its history and present challeges. Springer, Dordrecht, p 499-504]

Regime Shifts and Ecosystem Services

Conclusions and Final Recommendation

The value of different ecosystem components, monetary or otherwise, also depends on the needs, demands and perceptions of the local populations benefiting from them. Only if these are taken into account and assessed accurately, while also reconciling the management of potentially conflicting services such as commercial species with the protection of individual species and habitats it will be possible to convert the valuation of ecosystem services into efficient and coherent policy action and to address existing environmental legislation (Fig. 29.2) (Birol et al. 2006; Seppelt et al. 2011).

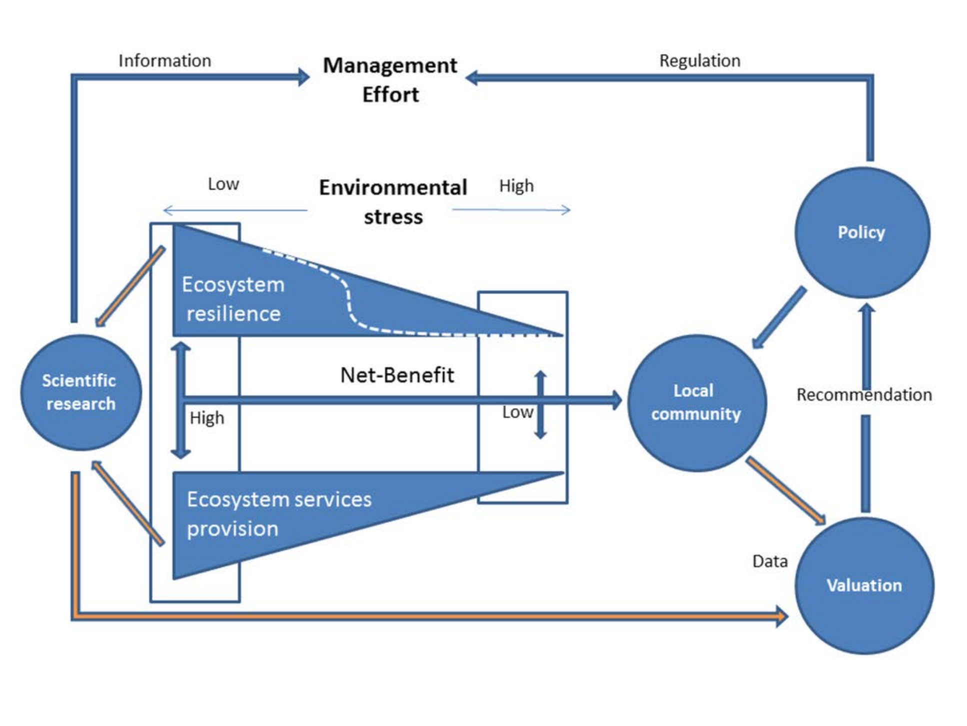


Fig. 29.2 Summary of the different players involved in the study and management of ecosystem services in the face of environmental stress including regime shifts. The *triangles* indicate the level of ecosystem resilience and resulting ecosystem services provision. The *stippled line* refers indicates a regime shift i.e. a sudden rather than gradual change in resilience

Sky TG24, 13/11/2016, ore 12:00 PM

«Il climate change è una bufala!»

«In effetti, è venti anni che se ne parla, ma non è successo molto!»

«Sono a metà d’accordo con Trump, ma un certa attenzione per l’ambiente bisogna mantenerla»

Regime Shifts in the Marine Environment: How Do They Affect Ecosystem Services?

[Kraberg A. C., Wiltshire K. H., 2014. Regime Shifts in the Marine Environment: How Do They Affect Ecosystem Services? In: Goffredo S., Dubinsky Z. (eds) The Mediterranean Sea: Its history and present challeges. Springer, Dordrecht, p 499-504]

Regime Shifts and Ecosystem Services

<u>Conclusions and Final Recommendation</u>

The value of different ecosystem components, monetary or otherwise, also depends on the <u>needs</u>, <u>demands</u> and <u>perceptions</u> of the <u>local populations</u> benefiting from them. Only if these are taken into account and assessed accurately, while also <u>reconciling</u> the management of potentially <u>conflicting services</u> such as commercial species with the protection of individual species and habitats <u>it will be possible to convert the valuation of ecosystem services into efficient and coherent policy action</u> and to address existing environmental legislation (Fig. 29.2) (Birol et al. 2006; Seppelt et al. 2011).

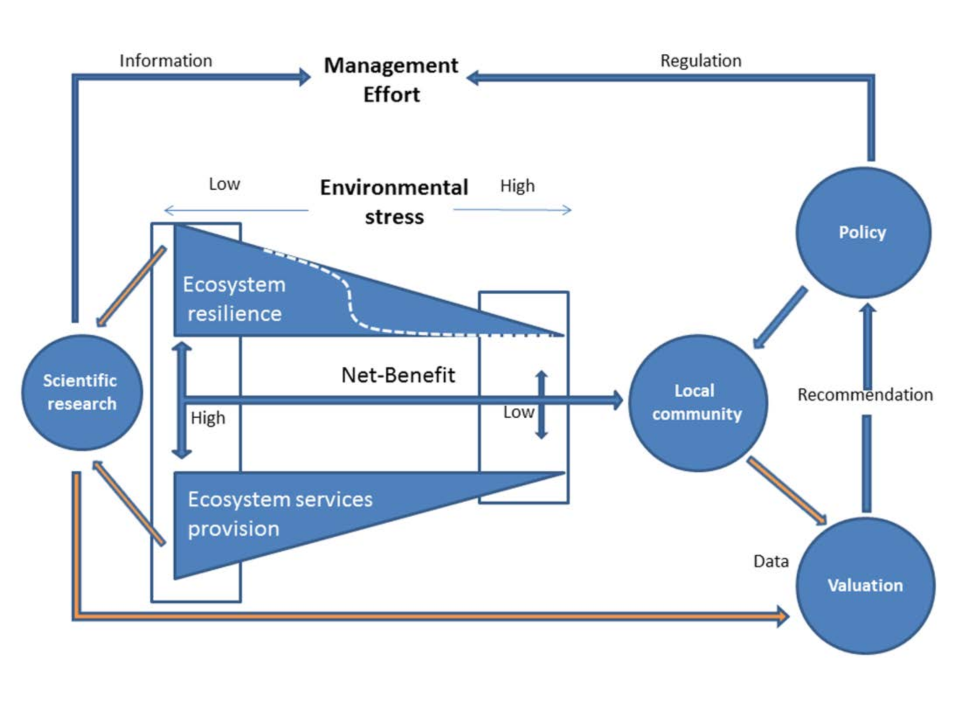


Fig. 29.2 Summary of the <u>different players</u> involved in the study and management of ecosystem services in the face of environmental stress including regime shifts. The *triangles* indicate the level of ecosystem resilience and resulting ecosystem services provision. The *stippled line* refers indicates a regime shift i.e. a sudden rather than gradual change in resilience

Regime Shifts in the Marine Environment: How Do They Affect Ecosystem Services?

[Kraberg A. C., Wiltshire K. H., 2014. Regime Shifts in the Marine Environment: How Do They Affect Ecosystem Services? In: Goffredo S., Dubinsky Z. (eds) The Mediterranean Sea: Its history and present challeges. Springer, Dordrecht, p 499-504]

Regime Shifts and Ecosystem Services

<u>Conclusions and Final Recommendation</u>

Clearly the overall <u>goal is the sustainable management</u> of coastal, and pelagic resources.

Recommendations:

1. Strengthening of <u>regional approaches</u> to the management of regime shifts and affected ecosystem services: the same ecosystem service might be valued very differently in different regions, both objectively in terms of monetary value, and in the public perception (Österblom et al. 2010).
2. <u>Continued maintenance but also the better co-ordination of data collection</u> and large-scale joint data analyses as well as better co-operation at different spatial scales and different types of agencies – essentially an interdisciplinary approach. Lastly, for such studies to be of relevant for the valuation of ecosystem services they should also address the information needs of <u>economists/social scientists</u> involved in ecosystem valuations. <u>Collaborative ties between economists and ecologists do not exactly have a long tradition but these have to be encouraged and fostered</u> (Turner 2000; Beaumont et al. 2007; Remoundou et al. 2009).